Computer Science at Oxford

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COMPUTER
SCIENCE

Computer Science at Oxford

- What's Computer Science about?
- The Oxford courses
- Four myths about Oxford

‘Russian’ multiplication

22	54

‘Russian’ multiplication

22	54
11	

‘Russian’ multiplication

22	54
11	
5	

‘Russian’ multiplication

22	54
11	
5	
2	

‘Russian’ multiplication

22	54
11	
5	
2	
1	

‘Russian’ multiplication

22	54
11	108
5	
2	
1	

‘Russian’ multiplication

22	54
11	108
5	216
2	
1	

‘Russian’ multiplication

22	54
11	108
5	216
2	432
1	

‘Russian’ multiplication

22	54
11	108
5	216
2	432
1	864

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864

‘Russian’ multiplication

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11	108
5	216
2	~~432~~
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	———

‘Russian’ multiplication

22	~~54~~
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5	216
2	~~432~~
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	1 8

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864
	88

‘Russian’ multiplication

22	~~54~~
11	108
5	216
2	~~432~~
1	864
	1188

Does it always work?

- Certainly for $22 \times 54 = 1188$.
- We've tried it for other examples too.
- But might there be one or two special numbers that make it go wrong?

Why does it work?

22	~~54~~
11	108
5	216
2	~~432~~
1	864

Why does it work?

22	~~54~~	0
11	108	
5	216	
2	~~432~~	
1	864	

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Why does it work?

$22 \times 54 = 11 \times 108$?

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$22 \times 54 = 11 \times 108$

$= 5 \times 216$?

22	~~54~~	0
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5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

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$$= 5 \times 216 + 108$$

$$= 2 \times 432 \ ?$$

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$$= 1188$$

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Why does it work?

$$22 \times 54 = 11 \times 108$$

$$= 5 \times 216 + 108$$

$$= 2 \times 432 + 324$$

$$= 1 \times 864 + 324$$

$$= 0 \times 1728 + 1188$$

$$= 1188$$

Always $a \times b = x \times y + z$.

22	~~54~~	0
11	108	0
5	216	108
2	~~432~~	324
1	864	324
0	1728	1188

Writing down the rules

1. Start with the two numbers to be multiplied in columns x and y, and 0 in column z.
2. Repeat until 0 appears in column x:
   - if x is odd, replace z by $y + z$.
   - replace x by $x \div 2$ and y by $2 \times y$.
3. The answer appears in column z.

Writing it as a computer program

$x := a;\ \ y := b;\ \ z := 0;$

while $x \neq 0$ **do**

  if $ODD(x)$ **then** $z := y + z$ **end**;

  $x := x \div 2;\ \ y := 2 \times y$

end;

return z

Hang on a minute!

Why not just use this program:

$$\textbf{return } a \times b$$

and have the multiplication done by an electronic circuit in the computer?

Hang on a minute!

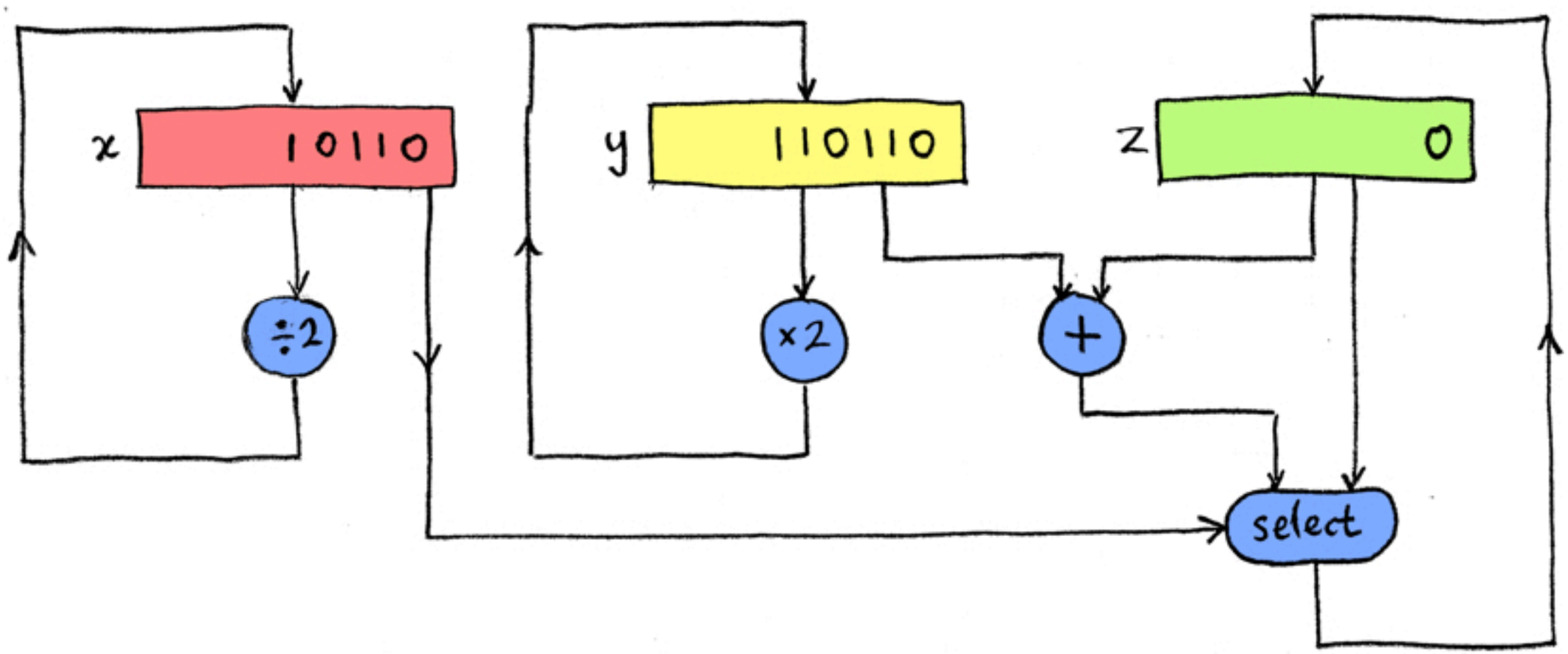
Why not just use this

return $a \times b$

```
mul r0, r1, r2
```

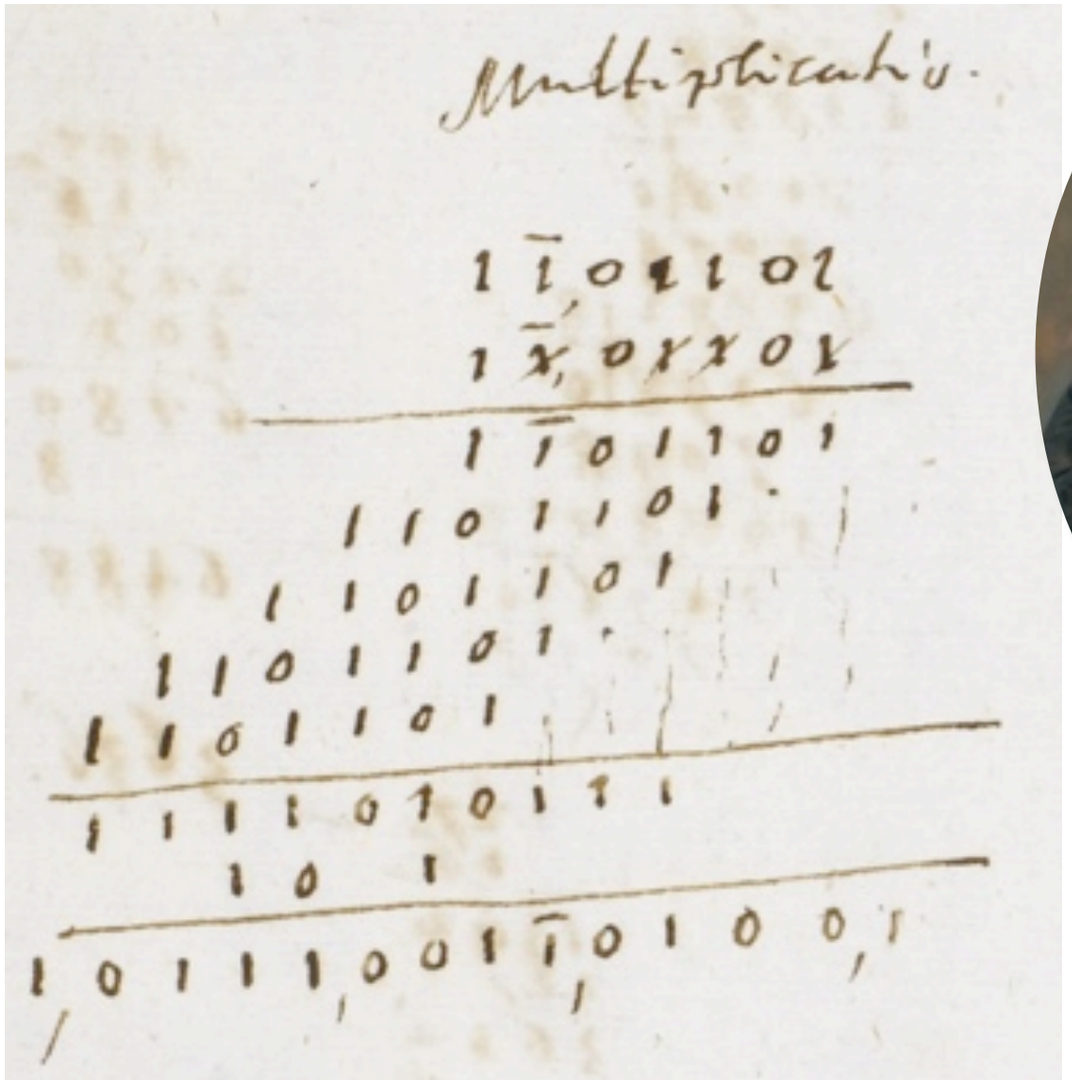
and have the multiplication done by an electronic circuit in the computer?

A multiplication circuit



A glimpse into history

Thomas Harriot (*c.*1560–1621):



Computer science

- It's *not* about learning new programming languages.
- It *is* about understanding why programs work, and how to design them.

In conclusion

- Computer programs (and computer hardware) are based on *algorithms* – fixed rules for calculating.
- If we want programs and computers to be reliable, we need to be able to explain why the answers are correct.
- Some computer systems do need to be totally reliable.

... and we need Maths for that.

Computer Science at Oxford

- What is Computer Science about?
- The Oxford courses
- Why Oxford?

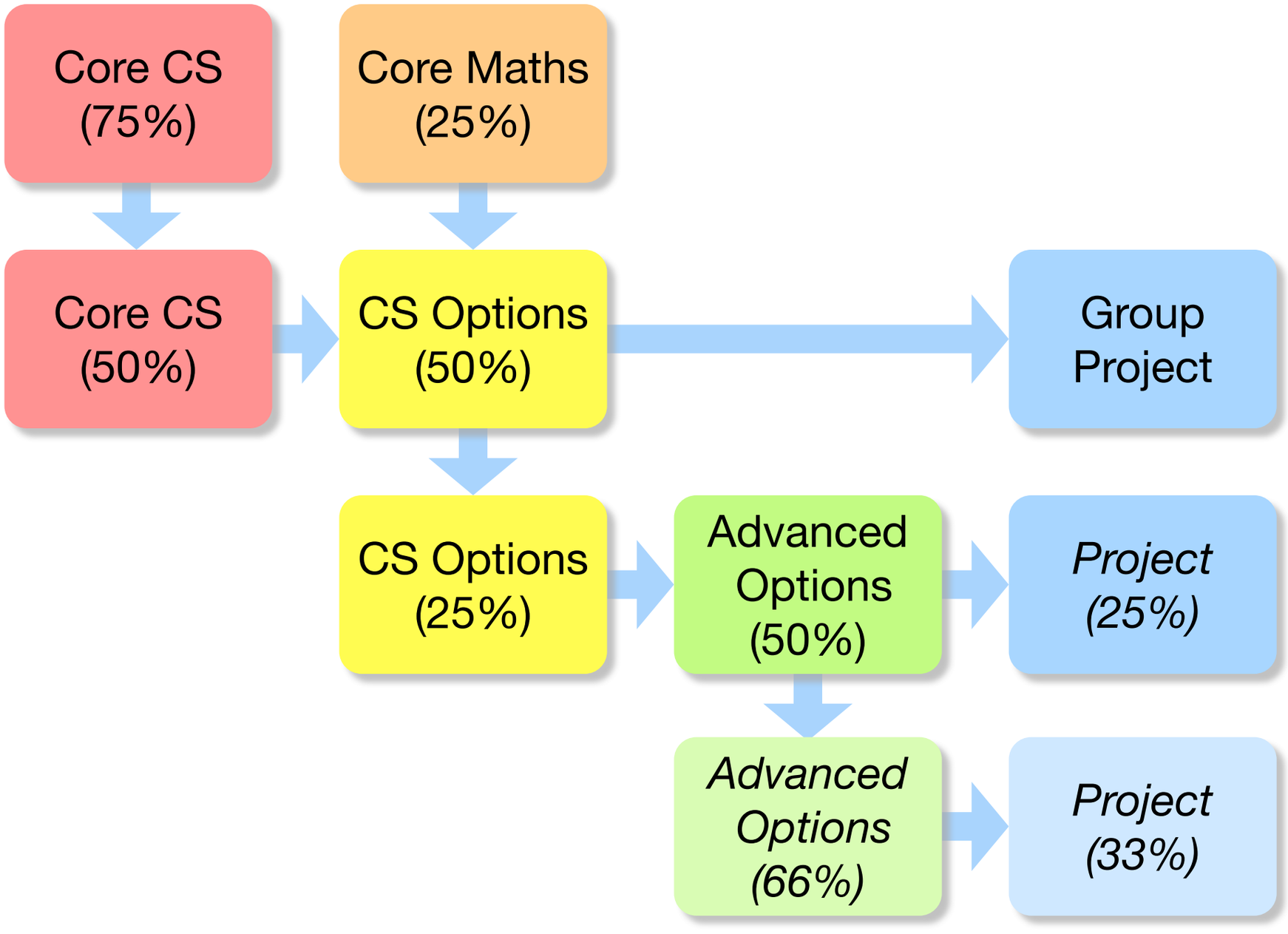
Computer Science

Year 1

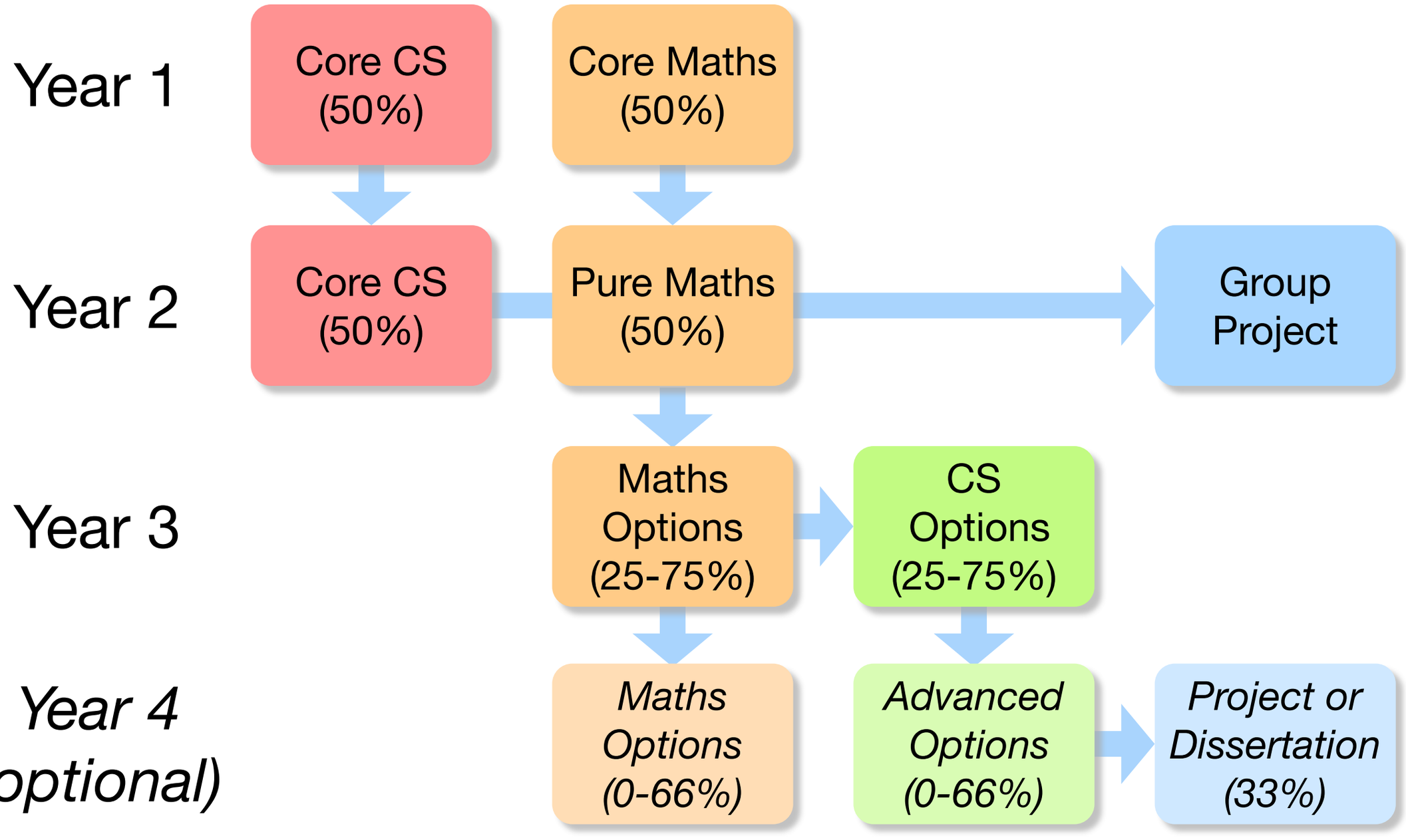
Year 2

Year 3

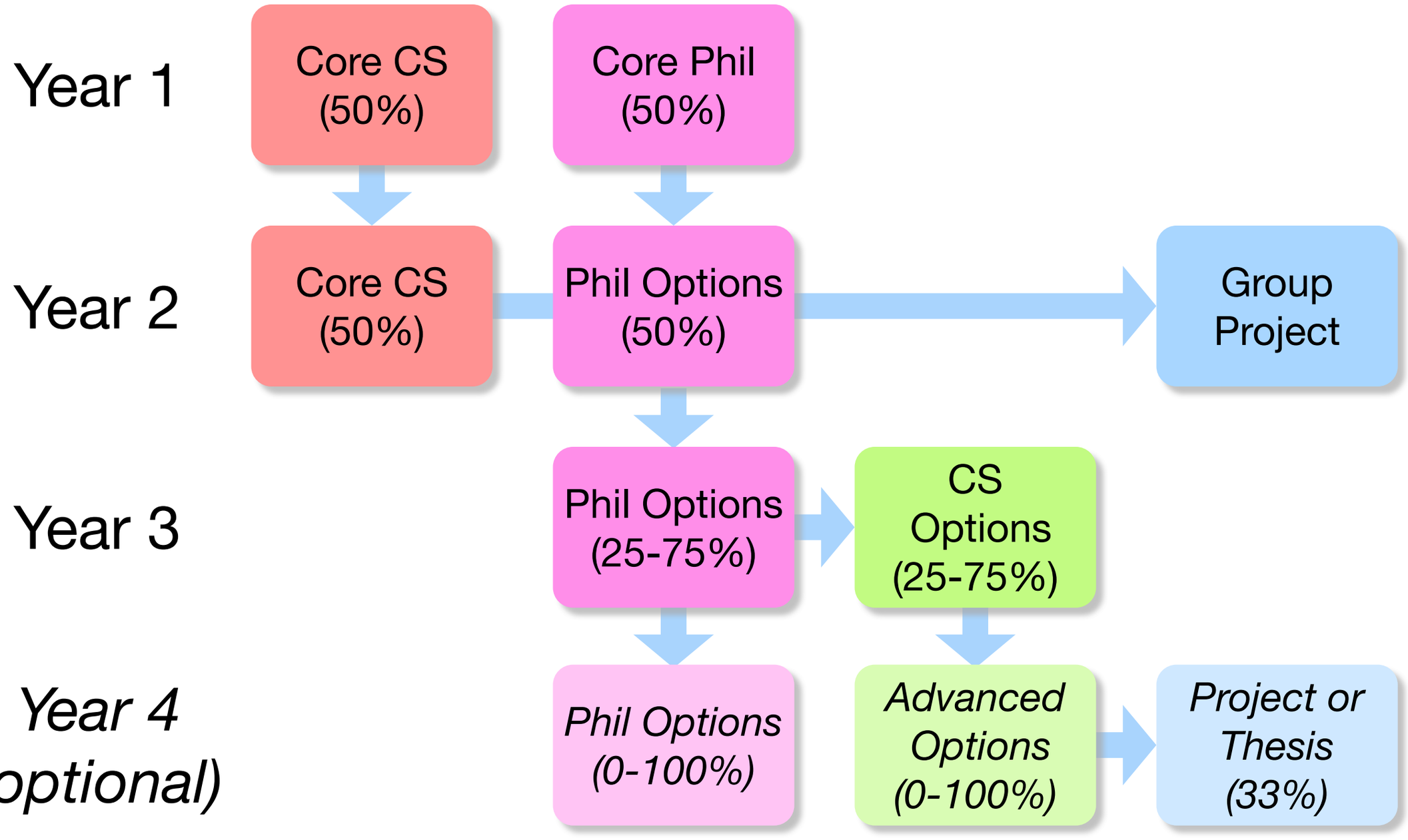
Year 4 (optional)



Maths & Computer Science



Computer Science & Philosophy



Why Oxford?

- Computer Science from the start.

  You study just Computer Science from day one, and we assume no prior knowledge.

- Principles behind the technology.

  You will learn the latest technology, but you will learn lasting principles as well.

- Personally-tailored tuition.

  Like all Oxford degrees, our teaching revolves around paired or one-to-one tutorials.

Why Oxford?

Academic

- A rigorous approach
- Able and keen fellow students
- Teaching from world experts

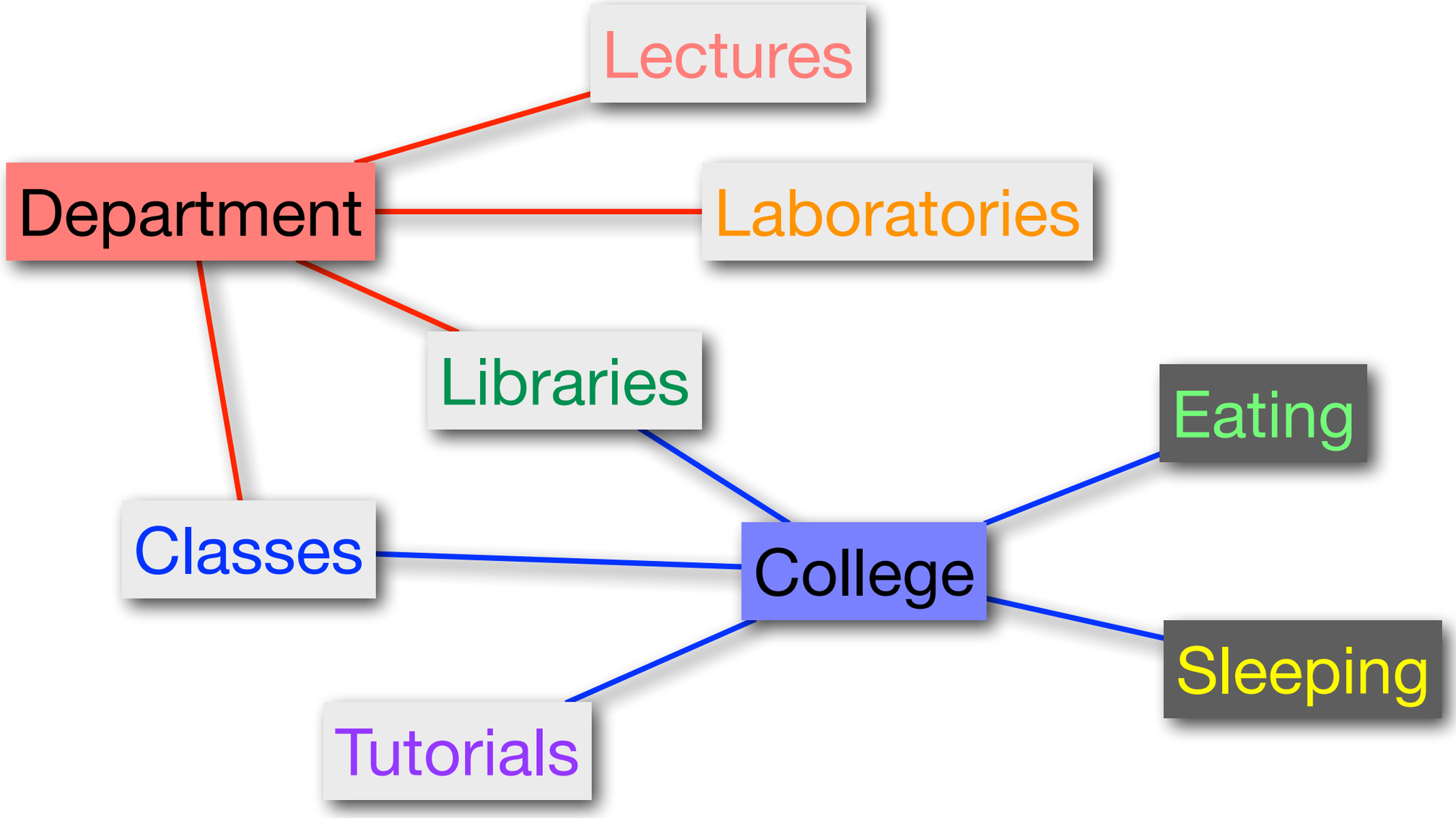
Social

- Rooms, books, meals
- Sport, politics, music, drama
- Making friends for life

Career

- Boundless opportunities await

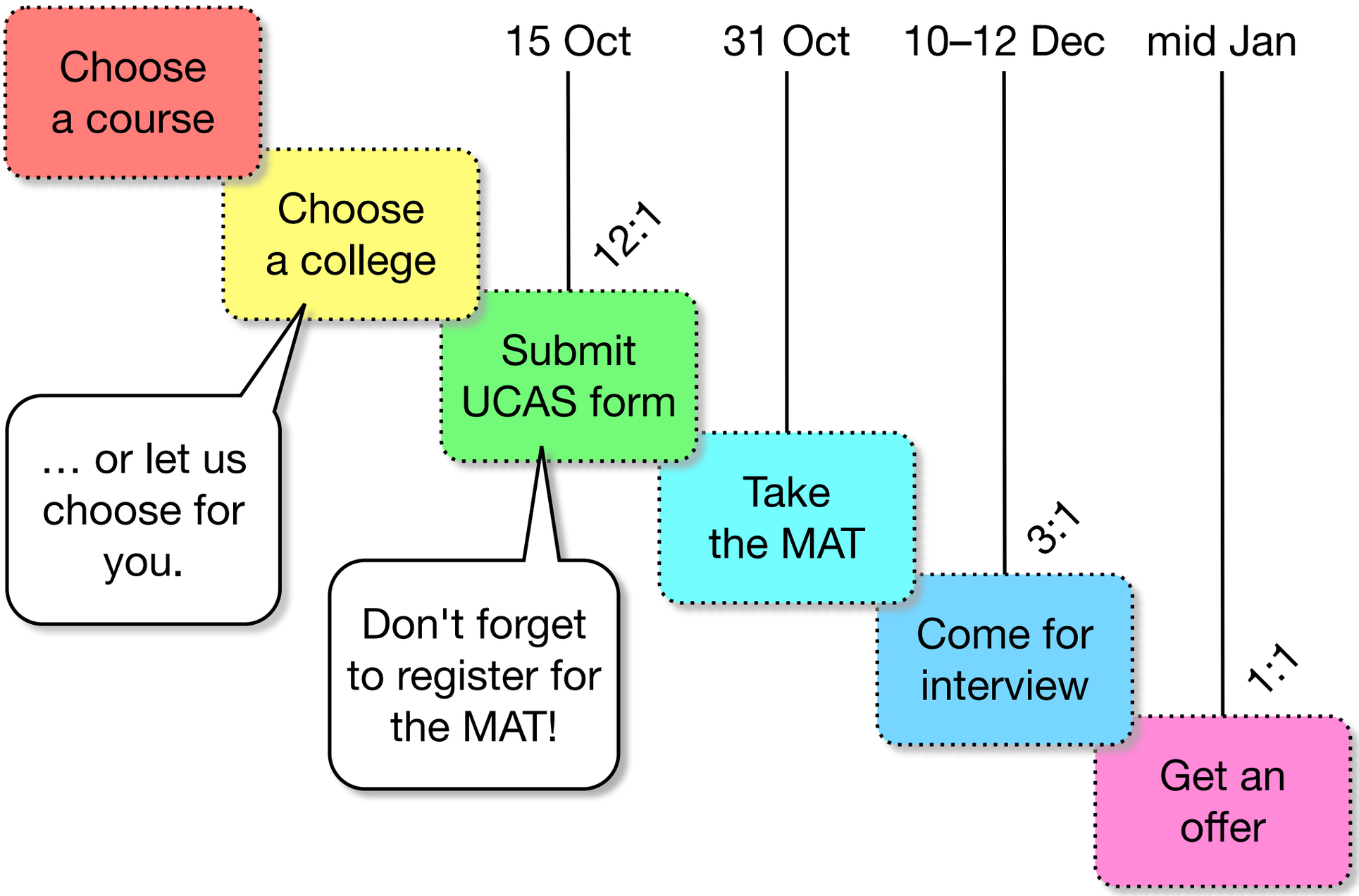
Studying at Oxford



Computer Science at Oxford

- What is Computer Science about?
- The Oxford courses
- The application process

Applications timeline 2018



Personal statement

- Be *personal* – What sets your application apart from others?
- Be *concrete* – Tell us what you have actually done.
- Be *specific* – Pick out highlights that paint a picture.

Mathematics Aptitude Test

Based on the 'common core' of A level Maths.

- Plenty of past papers online.
- You need to score 55–60 to get an interview.

We use *contextual information* when deciding who to invite for interview.

The interview

- We don’t ask trick questions.
- We want you to explain things to us.
- We want to have a conversation with you.

What are we looking for?

Potential

What have you done, and what does it say about you?

Independence

Can you work on your own with persistence?

Ability

Given some information, what can you do with it?

Creativity

Can you develop and refine your own ideas?

Motivation

Will you stay interested for 3 or 4 years?

Hard work

Do you give up easily?

Searching for the maximum

The real-valued function $f(x)$, defined for $0 \leq x \leq 1$, has a single maximum at $x = m$.

If $0 \leq u < v \leq m$ then $f(u) < f(v)$, and
if $m \leq u < v \leq 1$ then $f(u) > f(v)$.

You are told nothing else about f, but you may ask for the value of $f(x)$ at any values of x you choose.

How would you find the approximate value of m?

How accurately could find m if you could ask the value of $f(x)$ at only 10 values of x?

Lily-pad lunacy

Eleven lily pads are numbered from 0 to 10; a frog starts on pad 0 and wants to get to pad 10.

At each jump, the frog can move forward by one or two pads, so there are many ways it can get there.

For example, it can make 10 jumps by one pad, 1111111111, or five jumps by two pads, 22222, or go 221212 or 221122, and so on.

How many different ways can the frog get from 0 to 10?

Tidy boxes

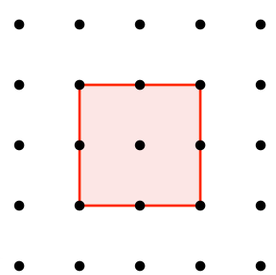
You are given 10 boxes, each large enough to contain exactly 10 wooden building blocks, and a total of 100 blocks in 10 different colours.

There may not be the same number in each colour, so you may not be able to pack the blocks into the boxes in such a way that each box contains only one colour of block.

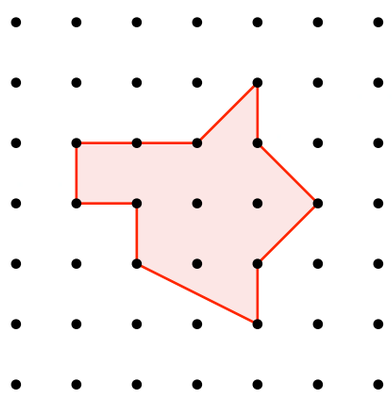
Show that it is possible to do it so that each box contains at most two different colours.

Stretching out the area

A perfectly elastic rubber band is stretched over some nails in a regular, square grid to form a polygon. We measure the area A of the polygon, and also count the number of points x inside it and the number y touched by the rubber band. What relates the numbers A, x, and y?



$x = 1$
$y = 8$
$A = 4$



$x = 3$
$y = 11$
$A = 7½$

The joy of coming second

The runner-up at Wimbledon is not necessarily the second-best entrant. How could we run the tournament so that we could be sure the second prize is awarded more fairly?

Let’s assume that the players play consistently according to some ranking, but that the ranking is unknown.

Four myths about Oxford

- It's hard to get in.
- It's very expensive.
- Choosing a college matters.
- You have to be very bright.

Myth 1: It's hard to get in

False!

- Statistically: you have a 10% chance – or better.
- Logistically: it's never been easier.

Myth 2: It's very **expensive**

False!

- Most colleges provide cheap accommodation for three years.
- College libraries and dining halls also help you save money.
- Increasingly, bursaries help students from poorer backgrounds.

Myth 3: Choosing a college matters

False!

- ‘Small’ colleges are often looking for good applicants.
- But do choose a college that has a tutor in your subject.

Myth 4: You have to be very bright

This one is true!

- We find it takes special qualities to benefit from the kind of teaching we provide.
- So we are looking for the very best in *potential*, *ability* and *motivation*.

Summary: the facts

- You have a good chance of getting in.
- Living expenses are geared to student budgets.
- Small colleges are worth applying to.
- We are looking for top ability, potential and motivation.